

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE SPECIFICATION**  
**WETLAND WILDLIFE HABITAT MANAGEMENT**  
(acre)  
**CODE 644**

**SCOPE**

This document establishes the technical details, workmanship, and quality and extent of materials required to install the practice in accordance with the Conservation Practice Standard. The information shall be considered when preparing site-specific specifications for the practice.

The site-specific specifications for installing, operating, and maintaining the practice on a specific field or treatment unit shall be documented via the NRCS Hawaii Jobsheet for this practice and given to the client. Other documents such as practice worksheets, maps, drawings, and narrative statements in the conservation plan may be used to plan or design the practice and to prepare the site-specific specifications.

**HABITAT ELEMENTS**

The types, amount, and distribution of the following wetland habitat elements have been identified for waterfowl and migratory birds; native freshwater fishes; and other aquatic vertebrates and invertebrates:

Habitat elements include:

- Island Occurrence (where found)
- Elevation Range (where found)
- Food (type)
- Nesting Cover (types of plants, trees, forest, etc. )
- Nesting Habits
- Escape Cover (types of plants, trees, forest, etc.)
- Threats (disease, habitat loss, other animal species, etc.)

**Water Fowl and Migratory Birds**

The habitat elements for the following water and migrant birds are listed in Table 1. Also see Table 2 for a listing of Wetland Plant Species Preferred by Waterbirds.

- Black-crowned Night-heron (*Nycticorax nycticorax*)
- Hawaiian Black-necked Stilt (*Himantopus mexicanus knudseni*)
- Hawaiian Common Moorhen (*Gallinula chloropus sandvicensis*)
- Hawaiian Coot (*Fulica alai*)
- Hawaiian Duck (*Anas wyvilliana*)
- Hawaiian Goose (*Nesochen sandvicensis*)
- Migrant Shorebirds (e.g. Ruddy Turnstone, Sanderling, Wandering Tattler)
- Pacific Golden Plover (*Pluvialis fulva*)
- Migrant Waterfowl (e.g. Northern Pintail, Northern Shoveler)



## **Native Freshwater Fishes**

The habitat elements for the following freshwater fishes are listed in Table 3.

- 'O'opu hi'ukole, alamo'o (*Lentipes concolor*)
- 'O'opu nopili (*Sicyopterus stimpsoni*)
- 'O'opu nakea (*Awaous guamensis*)
- 'O'opu naniha (*Stenogobius hawaiiensis*)
- 'O'opu akupa, okuhe (*Eleotris sandwicensis*)

## **Other Aquatic Vertebrates and Invertebrates**

The habitat elements for the following aquatic vertebrates and invertebrates are listed in Table 4.

- Hapawai (*Neritina vespertina*)
- Hihiwai (*Neritina granosa*)
- 'Opae kala'ole, kuahiwi (*Atyoida bisulcata*)
- 'Opae 'oeha'a (*Macrobrachium grandimanus*)
- Opae ula (*Halocaridina rubra*)
- Dragonflies (e.g. *Anax* spp.)
- Damselflies (e.g. *Megalagrion* spp.)
- Other native invertebrate species

## **GENERAL**

The identification of the required management actions to achieve the planned purpose, will be based on Hawaii Biology Technical Notes No. 4, 5, and 6 or other suitable wetland wildlife habitat evaluation procedures. The evaluation procedure will be used to determine a habitat suitability for either individual fields, habitat areas, type or natural community as well as to provide an overall evaluation for the entire property or operating unit.

Acceptable management actions include: manage vegetation; manage water levels; manage plant pests; manage animal pests, graze to control vegetation, and fallow cropped wetland.

Followings are guidance for implementing the acceptable management actions.

## **MANAGE VEGETATION**

Vegetation may be maintained, developed, or improved for food, nesting and/or escape cover. One or more of the following conservation practices may be implemented to achieve this:

- **CONSERVATION COVER – 327**
- **CRITICAL AREA PLANTING – 342**
- **FOREST SITE PREPARATION – 490**
- **IRRIGATION WATER MGT. – 449**
- **RIPARIAN FOREST BUFFER – 391**
- **TREE/SHRUB ESTABLISHMENT – 612**

- **WETLAND CREATION – 658**
- **WETLAND ENHANCEMENT – 659**
- **WETLAND RESTORATION - 657**

The practices should be implemented in compliance with the standards and specifications in the Field Office Technical Guide (FOTG). If a practice involves planting, a wetland planting plan will need to be developed and approved by the NRCS State Biologist or the Plant Materials Specialist.

## **MANAGE WATER LEVELS**

Hydrology is a key element necessary to maintain productive wetland wildlife species habitat. Refer to the attached tables to determine the required water depths, timeframes, and flow to meet the habitat elements of the target wildlife species. For waterbirds, the appropriate water level needs to be provided during the nesting timeframe. For native fish and other aquatic vertebrates and invertebrates, the target type of flow (e.g. plunge pools, rapids, runs) needs to be provided.

Bioengineering designs may need to be developed on a case-by-case basis or the following practices may be used:

- **STRUCTURE FOR WATER CONTROL – 587**
- **IRRIGATION WATER CONVEYANCE – 430**

## **MANAGE PLANT PESTS**

The following conservation practices may be implemented to manage plant pests (weeds, insects, and diseases).

- **BRUSH MANAGEMENT – 314**
- **PEST MANAGEMENT – 595**

The practices should be implemented in compliance with the standards and specifications in the FOTG. No pesticides are permitted within open water areas (e.g. ponds, lo'i, auwai). Only pesticides registered for use along waterway banks are permitted. All instructions on the pesticide labels must be followed.

Biological control (e.g., using predator or parasitic species) may be considered to manage plant and insect pests.

### **Mosquito Control**

Mosquitoes may be managed by reducing the number of breeding sites for mosquitoes in and adjacent to all essential bird habitats. Mosquitoes that carry diseases mainly breed in stagnant freshwater, including pig wallows and troughs. Exclusion of pigs from the wildlife area, and regular flushing of troughs (at least once a week) can also curtail mosquitoes.

## **MANAGE ANIMAL PESTS**

The management of animal pests (feral ungulates, rats, mice, mongoose, feral cats and dogs, invasive fish) can be accomplished by fencing, trapping, hunting, controlling pets and feral animals, controlling exotic fish, and/or using biological control.

## **Fencing**

Fencing may be used to maintain or protect and improve wetland wildlife habitat by restricting feral ungulates, including pigs, goats, deer, sheep, mouflon, and cattle. Fences may also serve to restrict the introduction of non-native, invasive plants, which may be spread by feral animals.

Note the threats and habitat elements of the target species in the tables, and use fencing as necessary. Fencing should be installed in compliance with the standards and specifications for the **FENCE (382)** practice in the FOTG.

## **Trapping**

Traps or poison-bait stations may be used to maintain or protect and improve habitat from feral animals.

From sea level to over 9,800 feet elevation, rats prey on native bird eggs, nestlings, and especially on Oahu, native land snails. Rat traps or poison-bait stations should be placed and maintained until rats are no longer a problem in selected areas. Black rats (*Rattus rattus*) and house mice (*Mus musculus*) respond well to diphacinone poison and to snapp trapping. Mongoose also respond well to diphacinone baiting. Rats favor apple or peanut butter flavored bait, while mongoose prefer fish flavored bait and a larger bait station. Larger traps than the ones used for mongoose are typically needed for feral cats.

Pigs have been successfully trapped through the use of corral traps or box-traps. The advantage of trapping of this kind is it does not require the use of toxins. The disadvantages are that trapping is labor intensive, and its application is limited to areas within reasonable proximity to vehicular access.

For specific trap types, schedules, spacing, and other requirements, contact the NRCS State Biologist and/or U.S. Fish and Wildlife Service (FWS), the State of Hawaii Department of Land and Natural Resources (DLNR) or other experience wildlife/habitat managers.

## **Hunting**

Feral ungulates may be controlled by hunting. Certain ungulates in Hawaii have specific hunting seasons, and may need permits. All hunting should be done in accordance with the DLNR hunting program.

Recreational hunting has not been shown to be effective in remote areas having rugged terrain with no roads for vehicular transit.

## **Controlling Household Pets and Feral Cats and Dogs**

Household pets and feral cats and dogs prey on waterbird eggs and young hatchlings. These animals should not be allowed in wetlands or streams. Dogs, especially, chase and harass birds to the point that they will not return to the wetland or stream. Dogs should be prevented from entering the wetland or stream by fencing or restraining (leashing) the animal.

## **Controlling Exotic Invasive Fish**

Some invasive exotic fish species, such as Tilapia, can be detrimental to wetland ecosystems. They compete for food with native species, in some cases eat native species, and they are known to negatively affect water quality. They should not be introduced in wetland areas and if

found should be removed.

### **Biological Control**

Biological control (e.g., using predator or parasitic species) may be considered to manage animal pests.

### **GRAZE TO CONTROL VEGETATION**

Grazing can be used to maintain or improve wetland vegetation or in some instances to control invasive vegetation (e.g. califonia grass). Domestic ungulates should be removed and excluded from the management area during nesting or roosting times and during stream migration. See Table 1 the proper times to exclude domestic ungulates.

Grazing should be implemented in compliance with the conservation practice standards for:

**PRESCRIBED GRAZING – 528A; and/or**

**FENCE – 382.**

Grazing should take place after the area has been inventoried and determined to have no impacts to threatened and endangered plant species.

### **FALLOW WETLAND CROPS**

Fields with wetland crops (e.g. taro, hasu) should be left wet after harvesting for a least one to three months because this provides critical feeding areas for endangered Hawaiian waterbirds. Check tables for target species to determine nesting times and nesting habitat requirements.

If a field is left fallow during nesting season, check for any potential nests before tilling the paddies or filling the paddies with water. Mowing berms should be done prior to this period to prevent the accidental harrasment of the birds.

If a waterbird nest is found while harvesting the wetland crop, plants supporting the nest should not be disturbed and a buffer of plants of at least six feet in diameter should be left around the nest.

### **REFERENCES**

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**TABLE 1: WATER BIRDS AND MIGRANT HABITAT ELEMENTS (Page 1 of 2)**

<u>Species</u>	<u>Island Occurrence</u>	<u>Elevation Range</u>	<u>Food</u>	<u>Nesting Cover</u>	<u>Nesting Habits</u>	<u>Escape Cover</u>	<u>Threats</u>
<b>Black-crowned Night-Heron</b> <i>Nycticorax nycticorax</i>	All main islands. Largest population is found at Kanaha Pond on Maui.	0 – 2,000 ft.	Primarily eats aquatic insects, fish, frog, and mice. Feeds at night.	Nests in colonies, close to water, often mangrove or hau trees.	Nests from April to August. In trees, large woody vegetation near water.	Mountain streams, lowland ponds, estuaries; marshes, ponds, streams, and lagoons.	Loss of wetland habitat, altered hydrology, avian disease, environmental contaminants.
<b>Hawaiian Black-necked Stilt</b> <i>Himantopus mexicanus</i>	All main islands, except Kahoolawe.	Rarely occurs in wetlands above 600 ft.	Eats variety of invertebrates and other aquatic organisms; polychaete worms, small crabs, aquatic insects, and small fish.	Nests on freshly exposed mudflats, interspersed with low growing veg; also on islands in fresh or brackish ponds; water depth < 6 in. Nest made for 4 eggs.	Nests March – Aug w/ peak May- June. Usually lays 3-5 eggs incubated ~ 24 days. Birds exhibit "broken wing" behavior, if nest threatened.	Requires early successional marshlands with water depth less than 6 in, perennial vegetation that is limited and low growing, or exposed tidal flats.	Loss of mudflat habitat; altered hydrology, avian disease, predation by alien mammals (e.g. mongoose) environmental contaminants.
<b>Hawaiian Common Moorhen</b> <i>Gallinula chloropus</i>	Kauai and Oahu.	0 – 400 ft.	Eats algae, grass seeds, wetland vegetation (see table 4), aquatic insects, mollusks.	Generally nests in areas with standing freshwater, less than 24 in deep; emergent vegetation to open water ratio 50:50. Nest size 15"-20" across, 2" deep.	Nests year-round, but most activity from March – August. Clutch size about 5 eggs. Incubation about 22 days.	Freshwater marshes, taro patches, reedy margins of water courses (streams, irrigation ditches, etc.), reservoirs, and wet pastures.	Loss of wetland habitat, altered hydrology, avian disease, environmental contaminants, predation by alien mammals (e.g.mongoose).
<b>Hawaiian Coot or 'alae ke'oke'</b> <i>Fulica alai</i>	All main Hawaiian islands, except Kahoolawe. On Molokai, coastal ponds & playa wetlands & Paialoa Pond.	0 – 5,000 ft.	Mostly eats seeds and leaves of aquatic plants (table 4), snails, crustaceans, aquatic or land insects, tadpoles, small fish.	Nests in open water fresh, brackish ponds, shallow reservoirs, ditches, marshes, vegetation to open water ratio 50:50 to 25:75. Nest size 24" across, 2" deep.	Nesting occurs mostly from March-Sept. Clutch size ranges from 3-10 eggs. Incubation period ranges from 23-27 days.	Inhabits fresh and saltwater ponds, estuaries, marshes; reservoirs associated with sugar cane production.	Habitat loss, inadequate vertebrate base, mangrove introduction.

**TABLE 1: WATER FOWL AND MIGRANT BIRDS - HABITAT ELEMENTS (Page 2 of 2)**

<u>Species</u>	<u>Island Occurrence</u>	<u>Elevation Range</u>	<u>Food</u>	<u>Nesting Cover</u>	<u>Nesting Habits</u>	<u>Escape Cover</u>	<u>Threats</u>
<b>Hawaiian Duck or Koloa</b> <i>Anas wyvilliana</i>	Kauai, Niihau, and Hawaii.  Oahu and Maui populations are hybrids.	Sea level to 9,900 ft.	Eats snails, dragonfly larvae, earthworms, grass seeds, rice, green algae, and seed and leaf parts of wetland plants (See Table 4).	Ground nests near water; optimum water level less than 5 in. Nest size 12-18" across, 4" deep.	Breed year-round; peak Jan. – May. Clutch size from 2-10 eggs. Incubation last about 30 days.	Freshwater marshes, flooded grasslands, coastal ponds, streams, montane pools, taro fields, and river valleys.	Hybridization with mallards, habitat loss, predation, damage to watershed by ungulates.
<b>Nene</b> <i>Nesochen Sandvicensis</i>	In Hawai'i: Ka'u district, SW slopes of Hualalai, windward Mauna Kea, & Mauna Loa. Maui: Haleakala.	4,300 – 7,900 ft.	Eats seeds of grasses and herbs; leaves, buds, flowers, and fruits of plants (See Table 4).	Nests on lava, but typically concealed in lumps of vegetation.	Peak nesting period Oct. to Feb. Clutch size from 3-5 eggs. Incubation from 29-31 days.	Inhabits rocky, sparsely vegetated, high volcanic slopes.	Habitat loss, predation, reproductive failure, poor survival in wild.
<b>Pacific Golden-Plover</b> <i>Pluvialis fulva</i>	All islands.	Sea level to 10,000 ft. or more.	Eats insects, snails and other invertebrates.	Migratory; returns from arctic nesting grounds in late September, remains until April.	Migratory.	Prefers open areas; short-grass fields, roadsides, sandy beaches, golf courses and mudflats.	Habitat loss, some predation by feral animals.
<b>Migrant Shorebirds</b> (e.g. Ruddy Turnstone).	All islands.	Up to 3,000 ft.	Eats aquatic invertebrates; fish, mollusks, plant material.	Migratory; returns from arctic nesting grounds in late September.	Migratory.	Usually in freshwater habitats, mudflats and ponds, in rocky shorelines, tidal flats, and rocky streams.	Habitat loss, some predation by feral animals.
<b>Migrant Waterfowl</b> (e.g. Northern Pintail)	All islands.	Up to 3,000 ft.	Prey includes fish, mollusks and other small invertebrates.	Migratory; returns from AK breeding grounds in April.	Migratory.	Usually in freshwater habitats.	Habitat loss, some predation by feral animals.

**TABLE 2: WETLAND PLANT SPECIES PREFERRED BY WATERBIRDS (NOT ALL-INCLUSIVE)**  
(Page 1 of 1)

PLANT SPECIES	EDIBLE PARTS	HABITAT
<i>Cyperus javanicus</i>	Nuts	Coastal marshes, taro lo'i
<i>Cyperus polystachyos</i>	Nuts	Freshwater to brackish
<i>Echinochloa crus-galli</i>	Inflorescence, leaves	Freshwater, taro lo'i
<i>Echinocloa colona</i>	Inflorescence, leaves	Freshwater
<i>Eleocharis geniculata</i>	Nuts	Freshwater
<i>Eragrostis spp</i>	Inflorescence	Freshwater to brackish
<i>Fimbristylis sp</i>	Nuts	Freshwater to brackish
<i>Juncus effusus</i>	Inflorescence	Freshwater
<i>Oryza sativa (rice)</i>	Inflorescence, leaves	Freshwater
<i>Paspalum orbiculare</i>	Inflorescence	Freshwater to brackish
<i>Polygonum spp.</i>	Inflorescence	Freshwater
<i>Scirpus sp</i>	Nuts, stems	Most species are freshwater
<i>Scleria spp</i>	Nuts	Freshwater to brackish

**TABLE 3: NATIVE FRESHWATER FISHES (GOBIES, O'OPU) - HABITAT ELEMENTS (PAGE 1 OF 1)**

<u>Species</u>	<u>Description</u>	<u>Elevation/Habitat</u>	<u>Food</u>	<u>Threats</u>
<b>'O'opu hi'ukole, alamo'o</b> ( <i>Lentipes concolor</i> )	Juveniles and females uniform olive to brown coloration; males have black heads and orange tails; length to 5 inches; endemic.	Found in middle to upper stream reaches. Can also be found near the stream mouth in streams that end in terminal waterfalls; most often in the mid-water pools; have strong affinity for fast riffles.	Algae, including <i>Microspora sp.</i> and Bacillariales; crustaceans, and insect larvae with the native mountain shrimp ('opae).	Water diversions, sedimentation, poor water quality, channelization, alien invasive fish.
<b>'O'opu nopili</b> ( <i>Sicyopterus stimpsoni</i> )	Variable coloration; juveniles and females mottled brown or gray; males often striped, and have pronounced dorsal fin; length to 7 inches; endemic.	Found in middle to upper stream reaches. Prefers fast flowing waters; restricted to relatively undisturbed streams with good water quality and a high rate of discharge.	Herbivorous, feeding on diatoms and filamentous blue-algae.	Water diversions, sedimentation, poor water quality, channelization, alien invasive fish.
<b>'O'opu nakea</b> ( <i>Awaous guamensis</i> )	Mottled brown and black, white belly; vertical stripes on dorsal and caudal fins; dark patch on caudal peduncle; length to 14 inches; indigenous.	Found in lower stream reaches, especially in streams with precipitous waterfalls; utilizes deeper, slower moving water.	Feeds on algae, worms, snails, and other bottom-dwelling aquatic organisms.	Water diversions, sedimentation, poor water quality, channelization, alien invasive fish.
<b>'O'opu naniha</b> ( <i>Stenogobius hawaiiensis</i> )	Yellow-brown coloration; may have 12 vertical black bands; diagonal black band through eyes; length to 5 inches; endemic.	Found in estuaries and lower stream reaches (brackish water); prefers soft-bottom areas; occurs mainly along stream margins and other low flow areas near the stream mouth; sometimes in irrigation ditches.	Feeds on plant and animal matter.	Water diversions, sedimentation, poor water quality, channelization Habitat destruction; human impacts, alien invasive fish.
<b>'O'opu akupa, okuhe</b> ( <i>Eleotris sandwicensis</i> )	Dark brown or black coloration; separate pelvic fins; length to 12 inches; endemic.	Found in estuaries and lower stream reaches; found only in stream reaches below the first precipitous waterfall.	Predatory carnivore; prey on small benthic invertebrates, snails, shrimp, insects, and other fish.	Water diversions, sedimentation, poor water quality, channelization, alien invasive fish.

**TABLE 4: OTHER AQUATIC VERTEBRATES AND INVERTEBRATES - HABITAT ELEMENTS (Page 1 of 1)**

<u>Species</u>	<u>Description</u>	<u>Food</u>	<u>Elevation/Habitat</u>	<u>Threats</u>
<b>Hapawai</b> ( <i>Neritina vespertina</i> )	Smooth thin shell, pale brown color; shell more flattened than hihiwai, usually with wing-like projections; white calcium deposits often on shell apex; up to 1 inch in diameter; endemic.	Feeds on algae growing on rocks.	Found in estuaries and lower stream reaches.	Water diversions, sedimentation, poor water quality, channelization.
<b>Hihiwai</b> ( <i>Neritina granosa</i> )	Shell black with faint rings; knobby projections present in varying degrees; rough to fairly smooth; underside of shell orange; up to 2 inches in diameter; endemic.	Feeds on algae growing on rocks.	Found in lower to mid-stream reaches; hide under boulders and in crevices during the day, coming out at night to forage and mate; require clear, cool well-oxygenated streams and avoid areas with high siltation.	Predation, esp. by Tahitian prawn, the Black Crown Night Heron and humans; sedimentation, poor water quality.
<b>'Opae kala'ole, kuahiwi</b> ( <i>Atyoida bisulcata</i> )	Golden-brown, dark green to black coloration; length to 2 inches; endemic.	Feeds on plant and animal matter.	Found in upper stream reaches or above the limits of fish distributions; are widespread can be found in habitats ranging from quiet pools to high velocity cascades.	Water diversions, sedimentation, poor water quality, channelization.
<b>Opae ula</b> ( <i>Halocaridina rubra</i> )	Tiny red shrimp.	Feeds on algae and bacteria.	Found in anchialine pools on the Big Island, Maui, Kaho'olawe, Molokai, and Oahu.	Coastal development, loss of habitat, alien invasive fish (e.g. Tilapia).
<b>'Opae 'oeha'a</b> ( <i>Macrobrachium grandimanus</i> )	Brownish coloration; males with one large and one small claw, which are vertically striped; length to 3 inches; endemic.	Feeds on plant and animal matter.	Found in estuaries or in streams below the first waterfall.	Water diversions, sedimentation, poor water quality, channelization.
<b>Dragonflies</b> (e.g. <i>Anax spp.</i> ) <b>Damselflies</b> (e.g. <i>Megalagrion spp.</i> ) <b>Other Native invertebrates</b>	Dragonflies are purple, gold, and bright red; only two blue species ( <i>Anax spp.</i> ) are endemic, are largest native insect. Rest with wings open.  Damselflies vary in color; most have striped color pattern on thorax. Rest with wings closed above body. <i>Megalagrion</i> species only found in HI.	Small insects. Dragonflies typically capture only flying insects. Damselflies capture those stationary and moving.	Streams, ponds, taro lo'i, some particularly adapted to plunge pools, seeps, spray zone of waterfalls.  Most damselflies and dragonflies are aquatic as immatures, molt to fly as adults.	Habitat loss, fish, particularly alien species; alien insects, water beetles, spiders, water diversions, channelization of streams.